A Citizen's Guide to Monitored Natural Attenuation

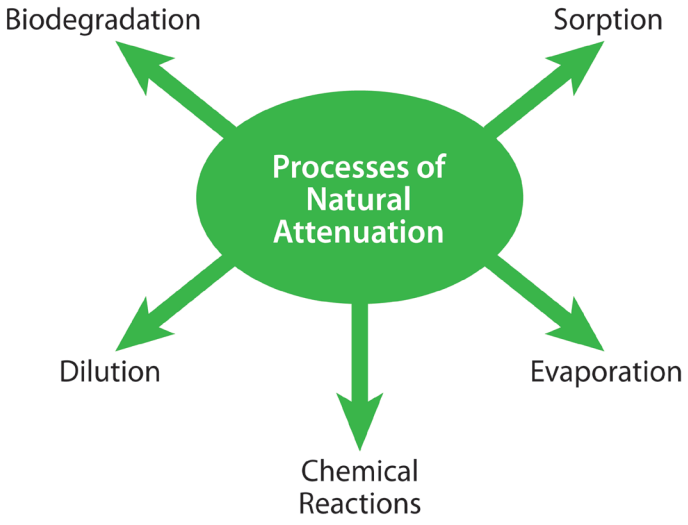
What Is Monitored Natural Attenuation?

Natural attenuation relies on natural processes to decrease or "attenuate" concentrations of contaminants in soil and groundwater. Scientists monitor these conditions to make sure natural attenuation is working. Monitoring typically involves collecting soil and groundwater samples to analyze them for the presence of contaminants and other site characteristics. The entire process is called "monitored natural attenuation" or "MNA." Natural attenuation occurs at most contaminated sites. However, the right conditions must exist underground to clean sites properly and quickly enough. Regular monitoring must be conducted to ensure that MNA continues to work.

How Does It Work?

When the environment is contaminated with harmful chemicals, nature may work in five ways to clean it up:

- *Biodegradation* occurs when very small organisms, known as "microbes," eat contaminants and change them into small amounts of water and gases during digestion. Microbes live in soil and groundwater and some microbes use contaminants for food and energy. (*A Citizen's Guide to Bioremediation* [EPA 542-F-12-003] describes how microbes work.)



- *Sorption* causes contaminants to stick to soil particles. Sorption does not destroy the contaminants, but it keeps them from moving deeper underground or from leaving the site with groundwater flow.
- *Dilution* decreases the concentrations of contaminants as they move through and mix with clean groundwater.
- *Evaporation* causes some contaminants, like gasoline and industrial solvents, to change from liquids to gases within the soil. If these gases escape to the air at the ground surface, air will dilute them and sunlight may destroy them.
- *Chemical reactions* with natural substances underground may convert contaminants into less harmful forms. For example, in low-oxygen environments underground, the highly toxic "chromium 6" can be converted to a much less toxic and mobile form called "chromium 3" when it reacts with naturally occurring iron and water.

MNA works best where the source of contamination has been removed. For instance, any waste buried underground must be dug up and disposed of properly, or removed using other available cleanup methods. When the source is no longer present, natural processes may be able to remove the remaining, smaller amount of contaminants in the soil or groundwater. The site is monitored regularly to make sure that contaminants attenuate fast enough to meet site cleanup objectives and that contaminants are not spreading.

How Long Will It Take?

MNA may take several years to decades to clean up a site. The actual cleanup time will depend on several factors. For example, cleanup will take longer when:

- Contaminant concentrations are higher.
- The contaminated area is large.
- Site conditions (such as temperature, groundwater flow, soil type) provide a less favorable environment for biodegradation, sorption or dilution.

These factors vary from site to site.

Is It Safe?

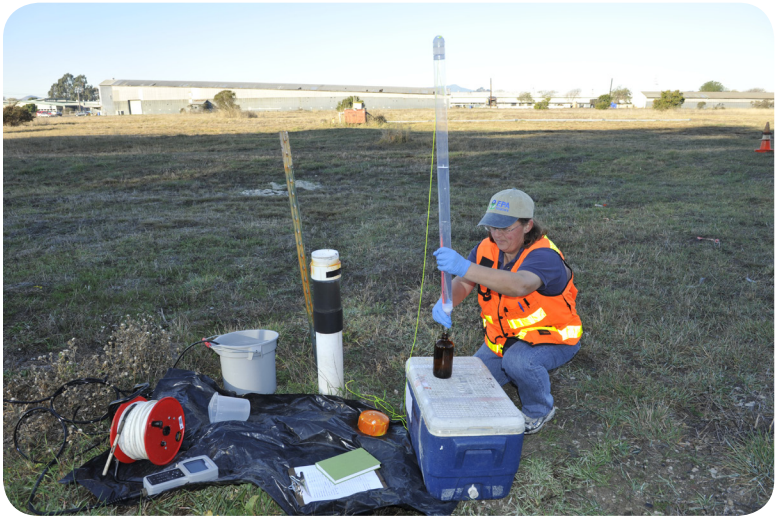
MNA does not pose a threat to the community or to site workers. MNA does not involve excavating soil or pumping groundwater to the surface for above ground treatment, so the potential to contact contaminants is limited. Long-term, regular monitoring is conducted to make sure contamination does not leave the site and that it is being attenuated at a rate that's consistent with cleanup goals for the site. This ensures that people and the environment are protected during the cleanup process.

How Might It Affect Me?

Generally, MNA does not cause much disruption to the surrounding community since no heavy machinery or other equipment is required during the MNA process. Residents and businesses near the site may initially see and hear drilling rigs when wells to monitor groundwater quality are installed. Once installed, workers will need to visit the site to collect samples of groundwater, soil or sediment to ensure MNA is working properly and is protective of human health and the environment. At those times, residents may hear the pumps and generators often used to collect groundwater samples from the wells.

Why Use Monitored Natural Attenuation?

MNA is selected when any contaminant source has been removed and only low concentrations of contaminants remain in soil or groundwater. The anticipated cleanup time for MNA must be reasonable compared to that of other more active cleanup methods. MNA requires less equipment and labor than most methods, which decreases cleanup costs. However, the cost of many years of monitoring can be high. MNA has been selected or is being used at over 100 Superfund sites across the country.



Monitoring natural attenuation at the site by collecting a groundwater sample.

Example

MNA is being used to complete groundwater cleanup at a former landfill on the Kings Bay Naval Submarine Base, Georgia. From 1993 to 2001, other cleanup methods were used to contain and treat the source of solvents in the groundwater. The goal was to reduce solvent concentrations to a level at which MNA would ensure safe concentrations at the property boundary, and unsafe levels of solvents would no longer flow beneath nearby housing. MNA was considered an efficient final treatment because of the right conditions for bioremediation to occur.

Monitoring for natural attenuation has been occurring monthly since 1998. Groundwater is being sampled for solvents and other conditions that indicate MNA is working. The long-term objective is to reduce contaminant concentrations across the site to below Maximum Contaminant Levels (MCLs). Concentrations have decreased at most wells, but the groundwater in the former source area is still expected to take decades to reach MCLs.

For More Information

For more information about this and other technologies in the Citizen's Guide Series, visit:

www.cluin.org/remediation
www.cluin.org/products/citguide
www.cluin.org/products/MNA

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